

# Contents

List of Plates	xiii
Case Study Contributors and Affiliations	xv

## SECTION 1 **Setting the Scene: Mediterranean Landscapes**

<b>1 Introduction</b>	<b>3</b>
1.1 Ecosystems	3
1.2 Mediterranean-type ecosystems	5
1.3 Defining mediterranean-type ecosystems	7
1.4 A brief history of early comparative mediterranean research	11
CASE STUDY 1: Early mediterranean ecosystem comparisons. A personal history Contributed by H.A. Mooney	14
1.5 Hotspots of biodiversity	17
<b>2 Characteristics of Mediterranean-Type Ecosystems</b>	<b>23</b>
2.1 Origins and biogeography	23
CASE STUDY 2: Assembly of mediterranean-type floras— convergence, exaptation, and evolutionary predisposition Contributed by David D. Ackerly and Renske E. Onstein	27
CASE STUDY 3: The role of environmental stability in explaining variation in plant diversity in mediterranean-type ecosystems Contributed by Richard M. Cowling	34
2.2 Introduction to ecosystem drivers and processes	35
2.2.1 <i>Climate</i>	35
CASE STUDY 4: Freezing as an understudied driver of plant distribution within mediterranean-type ecosystems Contributed by Stephen D. Davis and George Matusick	39
2.2.2 <i>Fire</i>	43
2.2.3 <i>Topography and geology</i>	47
2.2.4 <i>Soils and mineral nutrition</i>	51

2.3 Evolutionary convergence	53
2.4 An overview of mediterranean-type ecosystem characteristics	56

## SECTION 2 **Painting the Picture: The Living Template**

<b>3 Organisms and their Interactions</b>	<b>69</b>
3.1 Organismal adaptations	69
3.1.1 <i>Plants</i>	70
3.1.1.1 <i>Phenology and life form</i>	70
3.1.1.2 <i>Roots, soils, and symbioses</i>	77
CASE STUDY 5: Pioneering research on proteoid root clusters in three mediterranean regions	80
Contributed by Byron B. Lamont and María Pérez-Fernández	
3.1.1.3 <i>Fire</i>	84
CASE STUDY 6: Central Chile compared to California: the enigma of the Chilean mediterranean-type climate flora	85
Contributed by Mary T.K. Arroyo	
3.1.2 <i>Animals</i>	87
3.1.3 <i>Microbes</i>	88
3.2 Diversity and endemism	89
3.3 Ecological and evolutionary context	91
3.3.1 <i>Edaphic communities</i>	92
3.3.2 <i>Animal and plant interactions</i>	92
3.3.2.1 <i>Plants and herbivores</i>	93
3.3.2.2 <i>Plants and pollinators</i>	94
3.3.2.3 <i>Plants and seed dispersers</i>	95
<b>4 Diversity and Community Structure</b>	<b>109</b>
4.1 Assembling plant communities	109
4.2 Shrublands	118
4.2.1 <i>Evergreen sclerophyll shrublands</i>	118
CASE STUDY 7: Mediterranean-type vegetation outside of mediterranean-type climate regions	119
Contributed by Philip W. Rundel	
4.2.2 <i>Heathlands—a component of evergreen sclerophyll shrublands</i>	123
4.2.3 <i>Drought-deciduous soft-leaved shrublands</i>	124
4.2.4 <i>Desert shrublands along arid margins</i>	125
4.3 Woodlands and forests	128
CASE STUDY 8: Large old (venerable) trees of fire-prone mediterranean-type climate regions	129
Contributed by Grant W. Wardell-Johnson	
4.4 Grasslands	133

4.5	Riparian communities	136
4.6	Vegetation dynamics: patchiness in space and time	138
<b>SECTION 3 Choreography: Life in Motion</b>		
<b>5</b>	<b>Evolution and Diversity</b>	<b>149</b>
5.1	Origins	149
5.2	Macroevolutionary patterns	155
5.2.1	<i>Divergence</i>	155
5.2.2	<i>Convergence</i>	160
	CASE STUDY 9: Mediterranean heathland and fynbos: a neglected example of convergence between mediterranean climate regions Contributed by Fernando Ojeda	160
5.2.3	<i>Extinction</i>	165
5.3	Diversity	165
5.4	Drivers of diversity	166
	CASE STUDY 10: The origin of the mediterranean biome Contributed by Philip W. Rundel	167
<b>6</b>	<b>Form and Function of Mediterranean Shrublands</b>	<b>177</b>
6.1	Structure and physiology	177
6.1.1	<i>Sclerophyllous leaves</i>	177
6.1.2	<i>Leaf traits other than sclerophylly</i>	182
6.2	Photosynthesis and growth	186
6.3	Responding to limited water	196
6.4	Demography and population dynamics: the key role of fire	200
6.4.1	<i>Fire regime</i>	200
	CASE STUDY 11: Linking fire traits and historical fire regimes in the mediterranean-type environment Contributed by Juli G. Pausas	202
6.4.2	<i>Shrub response to fire: from individuals to populations</i>	204
6.4.3	<i>Evolution of traits in response to fire</i>	206
<b>7</b>	<b>Ecosystems processes</b>	<b>219</b>
7.1	Ecosystem structure and primary productivity	219
7.2	Mineral nutrients	225
7.2.1	<i>Plant adaptations to low nutrients</i>	227
7.2.2	<i>Nutrients, fire, and decomposition</i>	229
7.3	Hydrology	231

SECTION 4 **The Modern Stage: Transformation**

<b>8</b>	<b>Transformation</b>	239
8.1	Threats to mediterranean-type climate regions	239
8.2	Human interactions with mediterranean-type climate region landscapes	241
8.3	Land-use, land-cover change	244
	CASE STUDY 12: Australian acacias—super invaders of mediterranean-type ecosystems	247
	Contributed by David M. Richardson	
	CASE STUDY 13: Land-use changes in an urbanizing world: a comparison between the city of Cape Town, South Africa and Los Angeles County, USA	251
	Contributed by Patricia M. Holmes and Alexandra D. Syphard	
8.4	Habitat fragmentation	258
8.5	Fire regime changes and habitat type conversion	259
8.6	Invasive species	263
	8.6.1 <i>Invasive plants</i>	263
	8.6.2 <i>Invasive animals</i>	267
	8.6.3 <i>Pathogens</i>	268
8.7	Nutrient enrichment	270
8.8	Climate change	271
8.9	Conclusion	276
<b>9</b>	<b>Planning for the future</b>	291
9.1	Introduction	291
9.2	Conservation approaches	293
	9.2.1 <i>Protected area expansion</i>	296
	9.2.2 <i>Conservation stewardship</i>	297
	9.2.3 <i>Biodiversity and spatial planning</i>	300
9.3	Ecological restoration and related activities	302
9.4	Climate change, altered disturbance regimes, and fire management	307
	CASE STUDY 14: Fire and climate change in mediterranean-type ecosystems	310
	Contributed by Max A. Moritz and Enric Batllori	
9.5	Conclusion	312
	Index	323

# List of Plates

- Plate 1** Landscape photos from each of the five mediterranean-type ecosystem (MTE) regions (a–e) (see p. 5).
- Plate 2** Convergent evolution of a succulent plant form in different deserts (a–d) (see p. 6).
- Plate 3** Conspicuous common northern hemisphere and southern hemisphere taxa (see p. 26).
- Plate 4** Examples of plants that re-establish through resprouting following fire (see p. 45).
- Plate 5** Examples of plants that re-establish through seeding following fire (see p. 46).
- Plate 6** Plant physical defence structures related to herbivory (see p. 94).
- Plate 7** Flowers may be suited for generalist or specialist pollinators (see p. 96).
- Plate 8** Arid shrub communities (see p. 126).
- Plate 9** Grassland in a mediterranean-type climate region (see p. 134).
- Plate 10** Relict species currently have limited distributions (see p. 156).
- Plate 11** Resprouting and non-resprouting species from the same genus (see p. 159).
- Plate 12** Adaptive leaf traits (see p. 184).
- Plate 13** Carnivorous and parasitic plants (see p. 230).
- Plate 14** Mediterranean region traditional land use (a, b) (see p. 246).
- Plate 15** A degraded Chilean landscape (see p. 257).
- Plate 16** Invasive alien plants (see p. 264).
- Plate 17** Pathogen impacts on mediterranean-type climate region plants (see p. 269).
- Plate 18** Drought-induced mortality (see p. 274).